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Assessment of Overwintering Populations of Dolly Varden in Selected Streams of the Seward Peninsula, Alaska, during 1991

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Preliminary investigations of anadromous Dolly Varden *Salvelinus malma* were conducted in Nome Area rivers during the spring and summer of 1991. Populations of Dolly Varden overwintering in the Nome and Solomon rivers of the Seward Peninsula were sampled during the fall of 1991. Population abundance, and length composition were estimated.

Dolly Varden sampled in the spring in the Nome River ranged from 286 to 549 millimeters in fork length while those in the Cripple River ranged from 303 to 536 millimeters.

The estimated abundance of Dolly Varden larger than 199 millimeters (fork length) overwintering in a 24 kilometer section of the Nome River was 3,006 fish (standard error = 213) or 125 fish/kilometer. Dolly Varden ranged in fork length from 270 to 600 millimeters.

The number of Dolly Varden larger than 199 millimeters (fork length) overwintering in a 15 kilometer section of the Solomon River was estimated at 3,972 fish (standard error = 717). The density was 265 fish/kilometer. Dolly Varden ranged in fork length from 227 to 600 millimeters.

Most Dolly Varden in the Nome and Solomon rivers (61 and 43 percent, respectively) were in the "quality" Relative Stock Density category. "Memorable" fish comprised 31 and 32 percent of the respective populations. No fish in the "trophy" category were sampled. Fish between 301 and 400 millimeters (fork length) accounted for 55 percent of the population in the Nome River and 35 percent of the population in the Solomon River.

KEY WORDS: Dolly Varden, *Salvelinus malma*, population abundance, length composition, Seward Peninsula, Nome River, Solomon River.

INTRODUCTION

The Seward Peninsula-Norton Sound area of western Alaska supports the second largest number of angler days of recreational fishing effort in the Arctic-Yukon-Kuskokwim (AYK) region (Mills 1981-1991). From 1980 to 1990, an average of 14,508 freshwater angler-days of fishing effort occurred in this area (Mills 1981-1991, Figure 1). Reported freshwater sport fish harvests consisted primarily of Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, pink *Oncorhynchus gorbuscha*, coho *Oncorhynchus kisutch*, chum *Oncorhynchus keta*, and chinook salmon *Oncorhynchus tshawytscha*, northern pike *Esox lucius*, whitefish *Coregonus spp.*, and burbot *Lota lota*. From 1980 to 1990, Dolly Varden accounted for 27% of the average harvest of these species (Table 1).

Although the Nome area is not connected by road to the state highway system, the Seward Peninsula contains approximately 420 km of gravel roads which are maintained by the State of Alaska from May through September. These roads originate in Nome and traverse the Seward Peninsula in three general directions: The Beam Road extending to the north, the Teller Road to the west and the Council Road to the east (Figure 2). This road system provides anglers access to many streams on the Seward Peninsula.

Populations of Dolly Varden on the Seward Peninsula are thought to be anadromous, with movement patterns showing similarities to populations farther north (DeCicco 1985, 1989). Dolly Varden overwinter and spawn in freshwater. Young fish reside in streams for two to five years (J. D. Reist, Department of Fisheries and Oceans, Winnipeg, Canada, personal communication) before first undertaking annual migrations to sea in summer. Fish migrate seaward as spring high water begins to recede and return to freshwater in late August or early September. Some fish which will spawn in the river in which they had overwintered, remain in freshwater the entire summer prior to spawning. In addition there is a prespawning migration into freshwater during late July and early August. Spawning occurs during September.

The first studies conducted by the Alaska Department of Fish and Game (ADF&G) on the basic life history of Dolly Varden in streams of the Seward Peninsula began in 1977 and continued through 1979. Nine streams were surveyed for fish presence and 174 Dolly Varden were sampled for age, weight and length. Angler counts were conducted periodically on 15 different streams (Alt 1978, 1979, 1980). Between 1979 and 1984, 23 Dolly Varden from the Fish/Niukluk rivers were sampled for age, length and weight (Alt 1985). During 1988, a project was initiated to survey Arctic grayling stocks residing in Seward Peninsula rivers (Merritt 1989). During this work, 30 Dolly Varden were tagged and sampled for length and age on the Nome, Snake, Sinuk, Solomon, Eldorado, Pilgrim, Kuzitrin, Niukluk and Fish rivers and Boston Creek. During 1989 and 1990, I made incidental observations concerning Dolly Varden residing in the Fish, Niukluk, Tisuk, Cripple, Penny, Sinuk and Pilgrim rivers while studying resident Arctic grayling populations.

Because the sport catch and harvest of Dolly Varden comprise a substantial portion of the sport fishery in waters of the Seward Peninsula, and because population data are lacking for Dolly Varden from this area, a research study

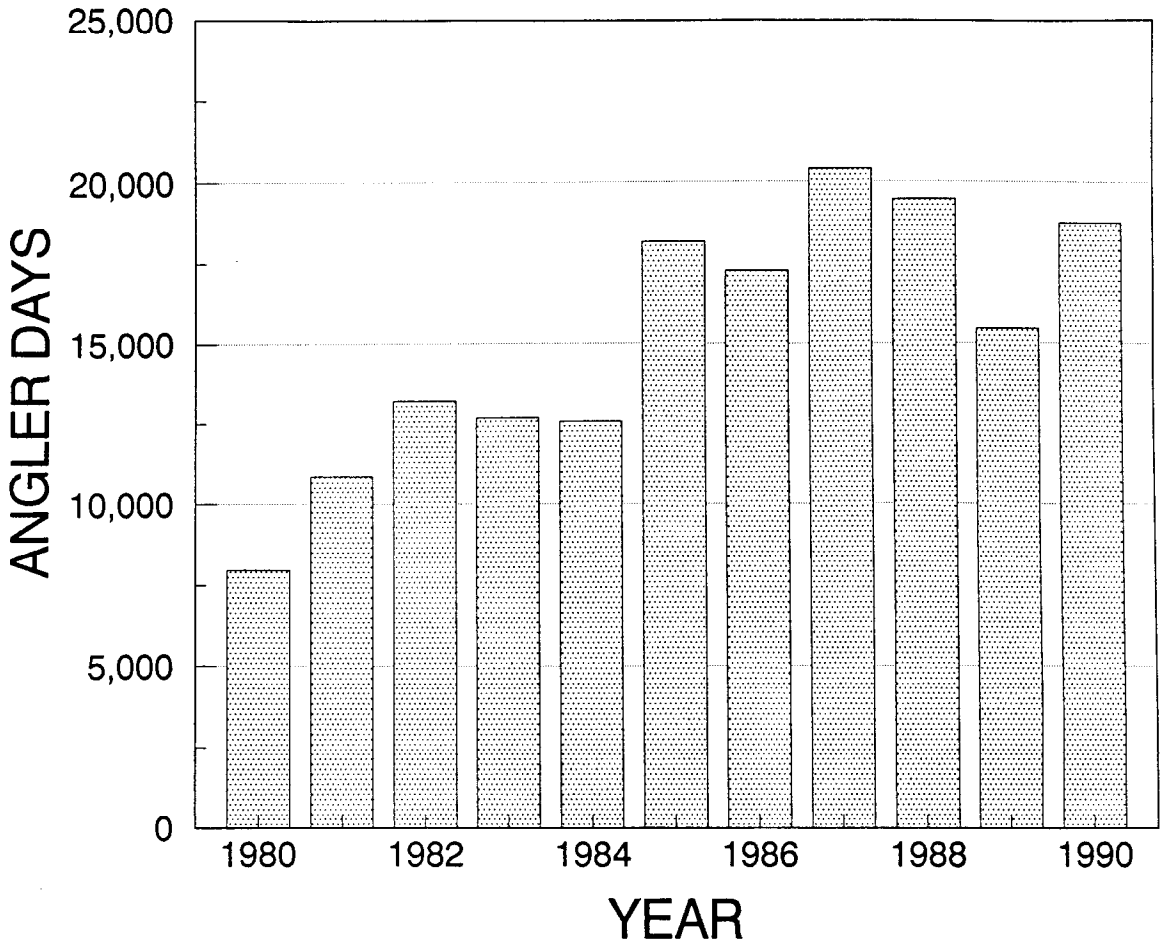

Figure 1. Freshwater sport fishing effort on Seward Peninsula and Norton Sound streams, 1980-1990.

Table 1. Freshwater sport fish harvests from Seward Peninsula and Norton Sound streams, 1980 to 1990[a].

Year	Days Fished	Harvests (catches) in number of fish. Salmon All Species	Dolly Varden	Arctic Grayling	Northern Pike	Burbot	Whitefish
1980	7,968	10,840	5,811	1,635	284	0	353
1981	10,879	6,564	3,981	2,104	303	0	123
1982	13,198	19,757	6,498	6,225	210	0	597
1983	12,678	10,189	9,779	8,241	798	0	148
1984	12,558	13,881	4,260	2,349	208	13	39
1985	18,141	3,401	5,695	4,501	56	175	70
1986	17,257	9,610	5,381	4,042	699	0	510
1987	20,381	5,415	5,506	4,600	906	0	272
1988	19,456	10,460	4,437	4,873	564	36	655
1989	15,443	8,548	7,003	4,205	648	10	453
1990[b]	18,720	11,227 (24,705)	3,765 (9,118)	1,378 (6,119)	1,957 (4,145)	33 (33)	299 (315)
Mean	15,153	9,991 (24,705)	5,647 (9,118)	4,014 (6,119)	603 (4,145)	24 (33)	320 (315)

[a] Data from Alaska statewide sportfish harvest surveys (Mills 1981 - 1991).
[b] The first year for which both harvest and catch were estimated.

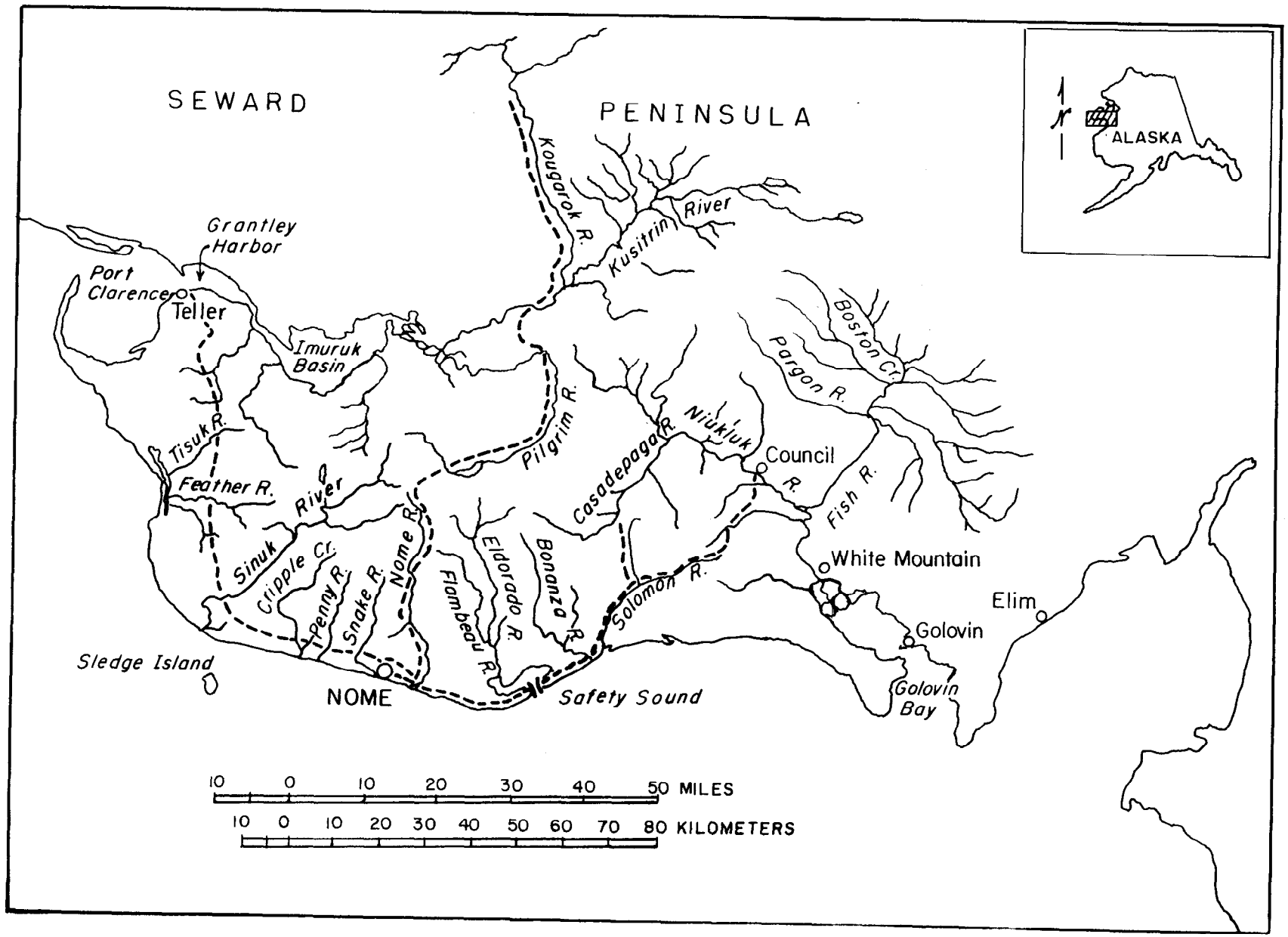

Figure 2. The southern Seward Peninsula showing roads and road accessible waters.

was initiated in 1991. Dolly Varden residing in the Nome and Cripple rivers were initially chosen for study. Dolly Varden have comprised 33% of the total fish harvest from the Nome River in recent years (Mills 1986-1990), and good accessibility is afforded to anglers. The Dolly Varden harvest per angler day in 1989 was higher in the Cripple River than most other rivers in the Nome area (ADF&G, Sport Fish Division, Statewide Harvest Survey project unpublished information) and it was thought that the small size of the Cripple River would facilitate efficient sampling of the Dolly Varden population.

During the spring of 1991, supplemental monies were made available for use in the Nome area. These funds allowed equipment to be purchased and prepared, and preliminary investigations to be undertaken in the Nome and Cripple rivers. The goals were to assess spring sampling conditions, to test different types of sampling gear and to determine the timing of the spring seaward migration of Dolly Varden in relation to water conditions. Most Dolly Varden which overwintered in the Nome River migrated to sea with spring high water (25 May to 2 June). Dolly Varden remaining in the Nome River were captured during June and incidentally throughout the summer while conducting research on Arctic grayling. The Dolly Varden population remaining in the Cripple River was sampled during late June.

During the summer of 1991 water levels of all rivers in the Nome area were extremely low. The Cripple River was floated in late June while spring high water was still receding and water levels were nearly inadequate for raft travel. By late summer, it was apparent that there was not enough water in the Cripple River to allow raft travel for fall sampling. The project objectives were therefore changed by substituting the Solomon River for the Cripple River. The Dolly Varden population residing in the Solomon River was chosen because it supports a popular fishery and good access is afforded from the Council Road.

Project objectives in 1991 were to estimate the abundance and length composition of Dolly Varden greater than 199 mm in fork length overwintering in the Nome and Solomon rivers.

METHODS

Sampling Gear and Techniques

During spring sampling, a 46 m x 2 m, 19 mm mesh beach seine, a drifted 16 m x 2 m gill net, with panels of 62 mm and 76 mm stretch mesh, and hook and line were used to capture Dolly Varden from the Nome and Cripple rivers. The Cripple River was floated using a 3.7 m Avon Redshank inflatable raft while the Nome River was accessed from the road. Each Dolly Varden captured was measured to the nearest mm in fork length (FL). Fish over 199 mm FL were tagged with individually numbered Floy FD-67 internal anchor tags which were inserted such that the "T" anchor locked between the base of adjacent dorsal fin rays. Each fish was also marked with an adipose fin clip (Appendix A1). External coloration was used to identify Dolly Varden which would spawn during the year of capture (Bain 1974). In addition to Bain's (1974) criteria, I have observed that spawning coloration first becomes evident as a duskiness on

the opercles. Data were recorded on standard ADF&G Tagging-Length forms (version 1). Data files were archived with ADF&G Research and Technical Services (RTS) in Anchorage (Appendix B1).

Fall concentrations of Dolly Varden were sampled in the Nome and Solomon rivers (Figures 3, 4) by using a 46 m x 2 m, 19 mm mesh beach seine deployed from a 3.7 m Avon Redshank inflatable raft. Each Dolly Varden was treated as described above.

Population Abundance Estimates

A modified Petersen mark-recapture experiment (Chapman 1951) was used to estimate the abundance of Dolly Varden in sections of the Nome and Solomon rivers. The entire length of each river section was sampled during both the mark and recapture events.

The assumptions necessary for the accurate estimation of abundance in a closed population are (from Seber 1982):

1. mortality or recruitment does not occur between sampling events (closed population);

2. fish have an equal capture probability in the first event or the second event, or marked fish mix completely with unmarked fish during the second sampling event;

3. marking does not affect capture probability in the second event;

4. marks are not lost between events; and,

5. marked fish can be recognized from unmarked fish.

Assumption 1 could not be tested directly. It was assumed that neither mortality nor recruitment occurred because both events were close together in time. Assumptions 2 and 3 were tested with two Kolmogorov-Smirnov two-sample tests (Conover 1980). The first test compared the cumulative length distribution of fish marked in the first sampling event (mark event) with those marked fish recaptured during the second sampling event (recapture event). The cumulative length distribution of fish captured during the marking event was compared with that of fish captured during the recapture event in a second test (Seber 1982). A more complete tracking of test results and consequences is contained in Appendix C1. All fish were released within the reach of the river in which they were captured. To meet conditions of assumption 4, all fish were double marked with a floy tag and an appropriate fin clip. Assumption 5 was met by the close examination of all fish and by the presence of the double mark.

Population abundance and the approximate variance of the estimate were calculated with the following formulas (Seber 1982):

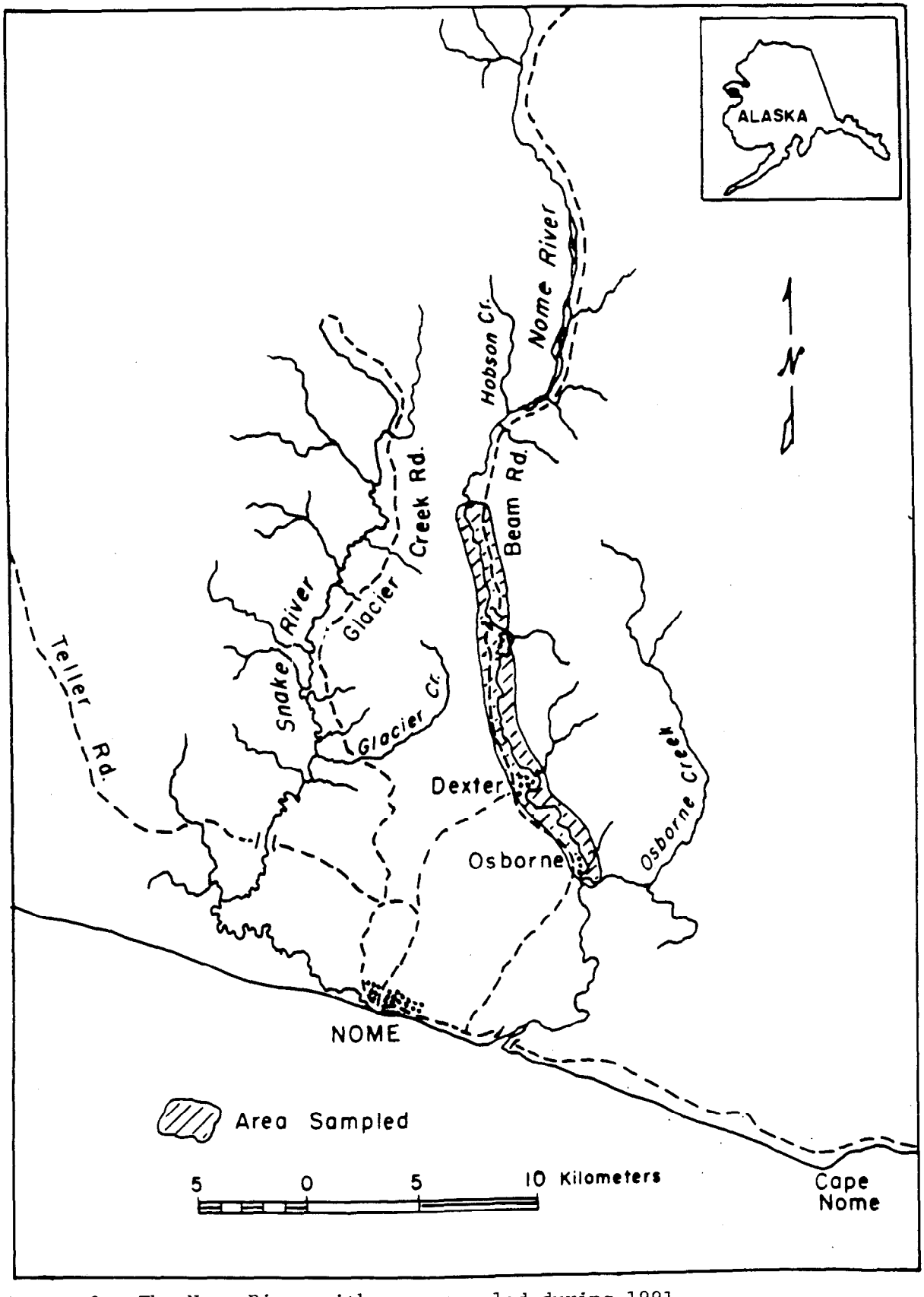

Figure 3. The Nome River with area sampled during 1991.

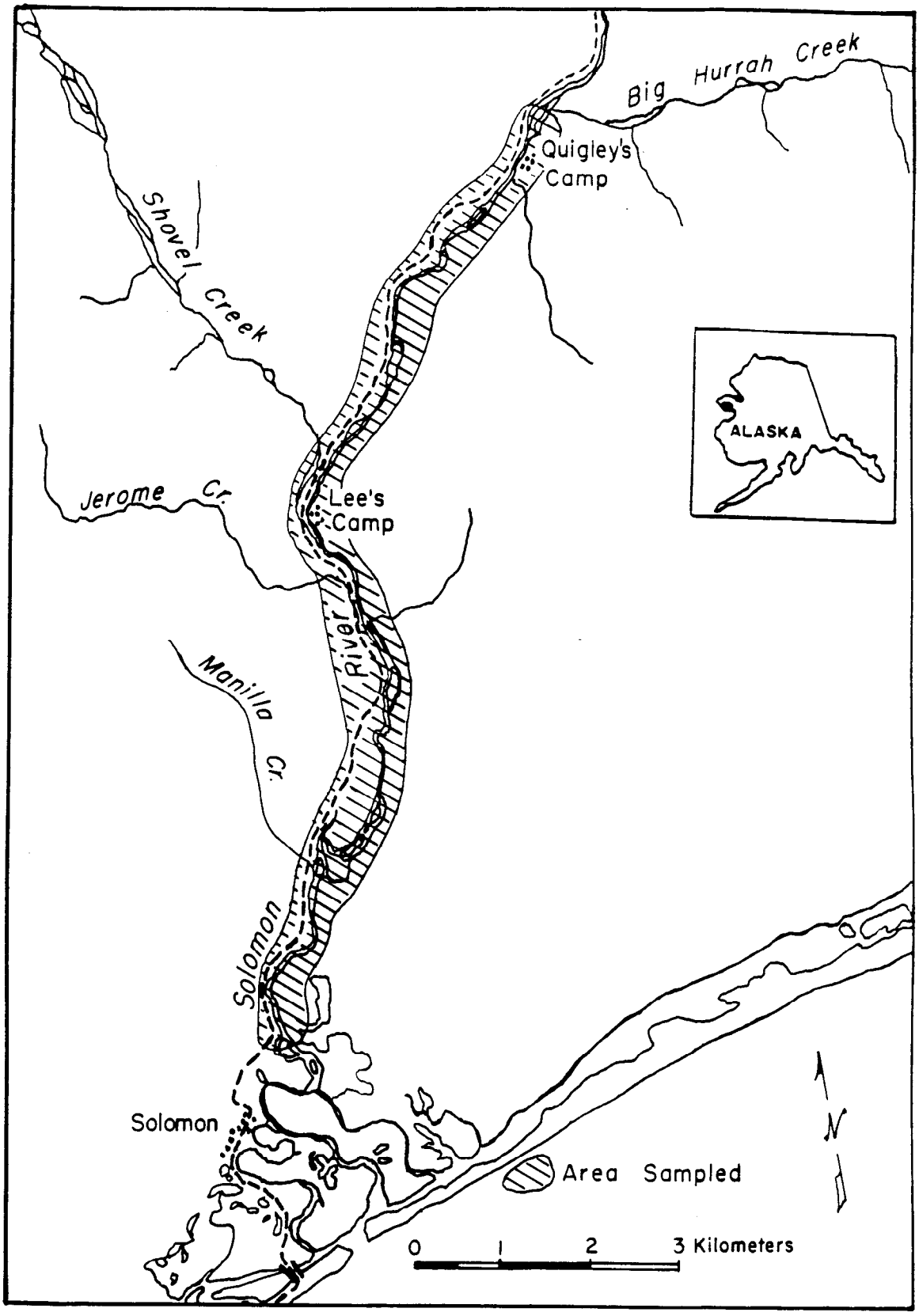

Figure 4. The Solomon River with area sampled during 1991.

$$\hat{N} = \frac{(C+1)(M+1)}{(R+1)} - 1; \text{ and,} \quad (1)$$

$$V[\hat{N}] = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)^2(R+2)} \quad (2)$$

where:

M = the number of Dolly Varden marked during the first period;

C = the number of Dolly Varden captured during the second period;

R = the number captured of Dolly Varden during the second period with marks from the first period;

$\hat{N}$ = the estimated abundance of Dolly Varden during the first sampling event; and,

$V[\hat{N}]$ = the approximate variance of the abundance.

Rivers were divided into sections and the ratios of recaptured fish to fish without tags examined during the second event by river section were tested for equal probability of capture using contingency table analysis. When the probabilities of capture were different by area, and movement between sections was significant but mixing was not complete, the abundance was estimated using the methods of Darroch (1961) and compared to a single unstratified estimate using the goodness of fit method (Seber 1982, pg. 121) as follows:

$$z = \frac{\hat{N}_a - \hat{N}_b}{(V_a + V_b)^{1/2}} \quad (3)$$

where:

$\hat{N}_a$ = the estimated abundance of Dolly Varden using the Darroch estimator;

$\hat{N}_b$ = the estimated abundance of Dolly Varden using the Petersen estimator;

V_a = the variance of the Darroch estimate;

V_b = the variance of the Petersen estimate;

z = the standard z statistic.

If the estimates were not different, i.e. $|z| < 1.96$, $\alpha = 0.05$, the estimate with the lowest variance was chosen.

Length Composition

Dolly Varden were sampled to estimate length composition in conjunction with the abundance estimates on the Nome and Solomon rivers. Length composition of Dolly Varden was partitioned into Relative Stock Density (RSD) categories (modified from Gabelhouse 1984). The RSD categories used for Dolly Varden were: "stock" (200 to 319 mm FL); "quality" (320 to 399 mm FL); "preferred" (400 to 509 mm FL); "memorable" (510 to 639 mm FL); and "trophy" (greater than 639 mm FL). Length composition was also described in 25 mm length increments. The proportions of fish in each length category were estimated as multinomial proportions (Cochran 1977).

The proportion of Dolly Varden in each length category was estimated as:

$$\hat{p}_j = \frac{n_j}{n} \tag{4}$$

where:

n_j = the number of Dolly Varden in the sample from length category j;

n = the sample size; and,

p_j = the estimated fraction of the population that is made up of length category j.

The unbiased variance of this proportion was estimated as:

$$\hat{V}[p_j] = \frac{\hat{p}_j(1-\hat{p}_j)}{n - 1} \tag{5}$$

Abundance of Dolly Varden by length category was estimated as follows:

$$\hat{N}_j = \hat{p}_j(\hat{N}) \tag{6}$$

where:

$\hat{N}_j$ = estimated number of Dolly Varden in length category j;

$\hat{p}_j$ = estimated proportion of Dolly Varden in length category j; and,

$\hat{N}$ = estimated abundance of Dolly Varden.

Variances for Equation 6 were estimated using Goodman's (1960) formula:

$$\hat{V}[\hat{N}_j] = (\hat{p}_j^2\hat{V}[\hat{N}])+(\hat{N}^2\hat{V}[\hat{p}_j])-(\hat{V}[\hat{p}_j]\hat{V}[\hat{N}]) \quad (7)$$

where:

$\hat{V}[\hat{N}]$ was obtained from the mark recapture analyses.

RESULTS

Preliminary Investigations

Preliminary sampling of Dolly Varden took place during May and June on the Nome and Cripple rivers, and during the summer on the Nome River incidental to Arctic grayling studies.

Nome River spawners:

Dolly Varden judged to be spawners in 1991 were sampled from the Nome River during the summer and during data collection for fall abundance estimates. Of the 187 spawners sampled, lengths ranged from 286 to 549 mm FL. Fish between 401 and 450 mm FL comprised 46% of the spawning Dolly Varden sampled from the Nome River (Figure 5).

Cripple River Dolly Varden:

During spring sampling on the Cripple River, 42 Dolly Varden were captured. They ranged from 303 to 536 mm FL, and all were judged to be 1991 spawners (Figure 5).

Population Abundance Estimates

Population abundance estimates germane to the fall of 1991 were calculated for Dolly Varden residing in the Nome and Solomon rivers.

Nome River:

Both the mark and recapture runs on the Nome River (Figure 3) were conducted during three day periods in September with a five day hiatus between events. A beach seine was used to sample Dolly Varden. Adequate numbers of fish were sampled during both events and a sufficient number of marked fish were recaptured to calculate an abundance estimate within desired precision criteria. The smallest Dolly Varden marked was 270 mm FL and the smallest Dolly Varden examined in the second event was 285 mm FL. The smallest recaptured fish was 297 mm FL.

In the 24 km section of the Nome River from Iron Creek to Osborne, the estimated abundance of Dolly Varden greater than 199 mm FL was 3,006 fish (SE = 213 fish, CV = 7.1%) or 125 fish per km. A total of 730 Dolly Varden

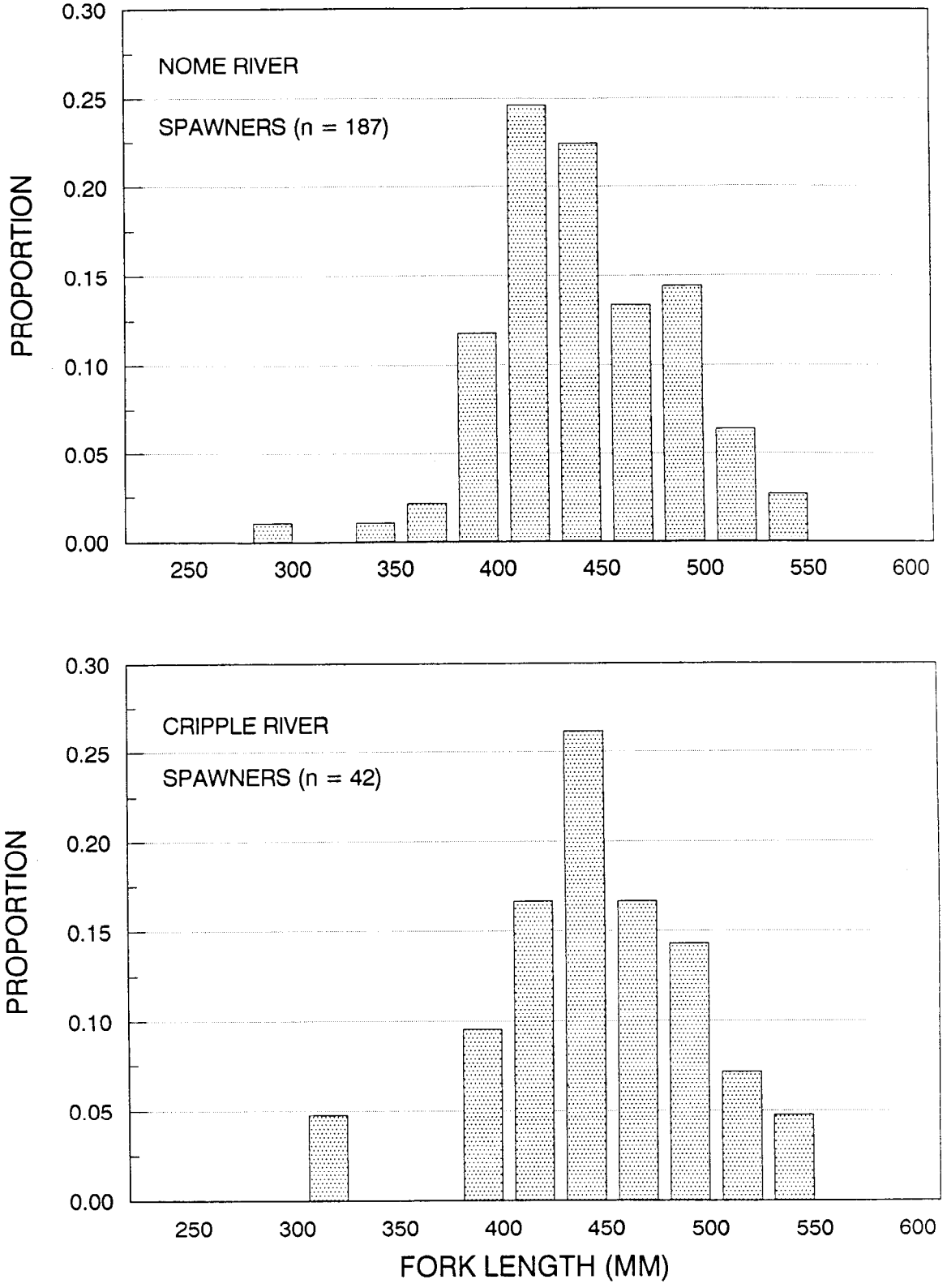

Figure 5. Length distribution of spawning Dolly Varden sampled from the Nome and Solomon rivers during 1991.

were marked during the first event (10 to 12 September). During the recapture event (18 to 20 September) 513 Dolly Varden were examined of which 124 had marks from the first sampling event. These include one fish (0.8%) which had shed its tag. One tagged fish was recovered in the Solomon River 12 days after it had been tagged.

Equal probability of capture by river section was examined by using contingency tables to compare the numbers of new fish examined in the second sampling event (total examined - recaptures) and of recaptured fish for the three river sections and was found to be different ($\chi^2 = 7.23$, df = 2, $0.025 < P < 0.05$). When individual sections were compared, differences were found between sections 1 and 2 ($\chi^2 = 5.60$, df = 1, $0.01 < P < 0.025$), and sections 2 and 3 ($\chi^2 = 6.92$, df = 1, $0.005 < P < 0.01$). However, sections 1 and 3 were found not to be different ($\chi^2 = 0.33$, df = 1, $0.50 < P < 0.75$). Considerable upstream and downstream movement was observed (Appendix D1). Both a Darroch estimate and an unstratified Petersen estimate were calculated and compared. The estimates were not statistically different ($z = 0.351$, $P \approx 0.375$; Darroch, N = 3,138; Petersen, N = 3,006). Therefore the unstratified estimate was chosen because it had the smallest variance.

Kolmogorov-Smirnov two sample tests of the cumulative length distributions of Dolly Varden greater than 199 mm FL marked versus those recaptured during the recapture event (test 1) and of those captured during the mark event versus those examined in the recapture event (test 2) failed to detect significant differences (test 1: $D = 0.11$, $P = 0.19$, $n_1 = 727$, $n_2 = 124$; test 2: $D = 0.06$, $P = 0.16$, $n_1 = 727$, $n_2 = 513$, Figure 6). Therefore, stratification by length-group was not necessary. Samples from both events were combined for length composition estimates.

Solomon River:

A beach seine was used to capture Dolly Varden from the Solomon River (Figure 4). The marking event occurred during four days in September and the recapture event was conducted during four days after a seven day hiatus. Fishing success was good during both events. Adequate numbers of fish were sampled during both events and a sufficient number of marked fish were recaptured to calculate an abundance estimate within the desired precision criteria. The smallest Dolly Varden marked was 227 mm FL and the smallest Dolly Varden examined in the second event was 257 mm FL. The smallest of 24 fish recaptured from the Solomon River was 290 mm FL.

In the 15 km section of the Solomon River from Big Hurrah Creek to 2 km downstream from Manilla Creek, the estimated abundance of Dolly Varden > 199 mm FL was 3,972 (SE = 717 fish, CV = 18.1%). A total of 372 Dolly Varden were marked during the first sampling event (11 to 16 September). During the recapture event (24 to 27 September), 266 Dolly Varden were examined of which 24 had tags from the marking event. No tag losses from the first event were observed. One tagged fish was recovered by a subsistence fisherman in the ocean 15 days after it was tagged.

Equal probability of capture among the three river sections was tested with contingency tables comparing the number of new fish examined in the second

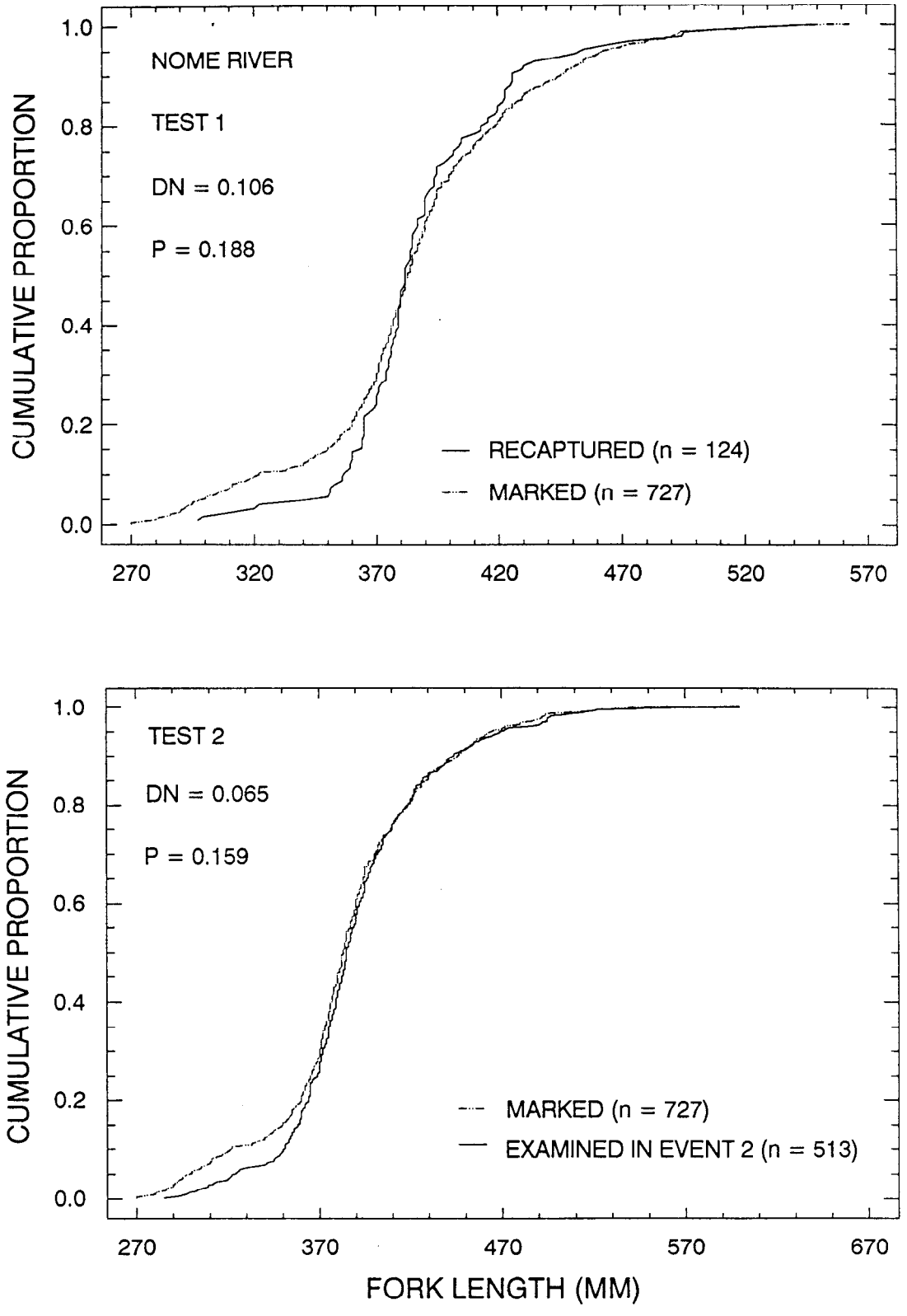

Figure 6. Cumulative length distribution plots (tests 1 and 2) of Dolly Varden sampled from the Nome River in 1991.

sampling event (total examined - recaptures) and the number of recaptured fish and was found to be statistically different (χ^2 = 8.29, df = 2, P = 0.016). Only four of the fish (1.5%) from the second sample were caught in section 1 during the recapture event. When a like comparison was made between sections 2 and 3, capture probabilities were not statistically different (χ^2 = 0.48, df = 2, P = 0.827). When sections 1 and 2 were combined and compared to section 3, capture probabilities were not statistically different (χ^2 = 0.37, df = 2, 0.75 < P < 0.90). Therefore all three sections were combined and a single unstratified abundance estimate was calculated.

Kolmogorov-Smirnov two sample tests of the cumulative length distributions of Dolly Varden greater than 199 mm FL marked versus those recaptured during the recapture event (test 1) failed to detect a significant difference (D = 0.18, P = 0.45, n_1 = 370, n_2 = 24). However a like test of those captured during the marking event versus those examined in the recapture event (test 2) did detect a significant difference (D = 0.13, P = 0.01, n_1 = 370, n_2 = 266, Figure 7). This test suggests that there is length bias in the first sample and only the second sample be used for length composition estimates. Upon inspection of the Kolmogorov-Smirnov plot for test 2, there appeared to be no functional differences between lengths of fish marked and of those examined in the second event. If length bias in the first sample is slight, there should not be significant differences between the second sample and the combined first and second samples. If these length compositions are not significantly different, the advantages of larger sample sizes, using the combined sample, should outweigh the disadvantages of slight bias introduced by adding the first sample. A contingency table was used to compare the length composition by 25 mm increments of the second sample with the combined first and second samples for fish of fork lengths between 250 and 525 mm, the length range which showed the greatest differences in the Kolmogorov-Smirnov plot. Significant differences were not found (χ^2 = 10.61, df = 10, 0.25 < P < 0.50). The combined sample was therefore used for length composition estimates.

Length Composition

Length composition of Dolly Varden populations overwintering in the Nome and Solomon rivers was partitioned into RSD categories (Figure 8) as well as in 25 mm increments (Figure 9). The majority of Dolly Varden were in the quality and preferred categories (Table 2). Relative Stock Densities were significantly different between the rivers (χ^2 = 101.03, df = 3, P <0.001). Dolly Varden in the quality category comprised 61%, and 42%, while preferred fish comprised 31% and 32% of the respective size compositions in the Nome and Solomon rivers in 1991. Memorable fish were weakly represented in both rivers (< 2%), and no fish in the trophy category were encountered in either river. Examination of length composition by 25 mm increments also showed significant differences between rivers (χ^2 = 13.47, df = 11, P <0.001). The highest proportion of fish in each river was in the 376 - 400 mm FL range, 32% in the Nome River and 18% in the Solomon River (Table 3).

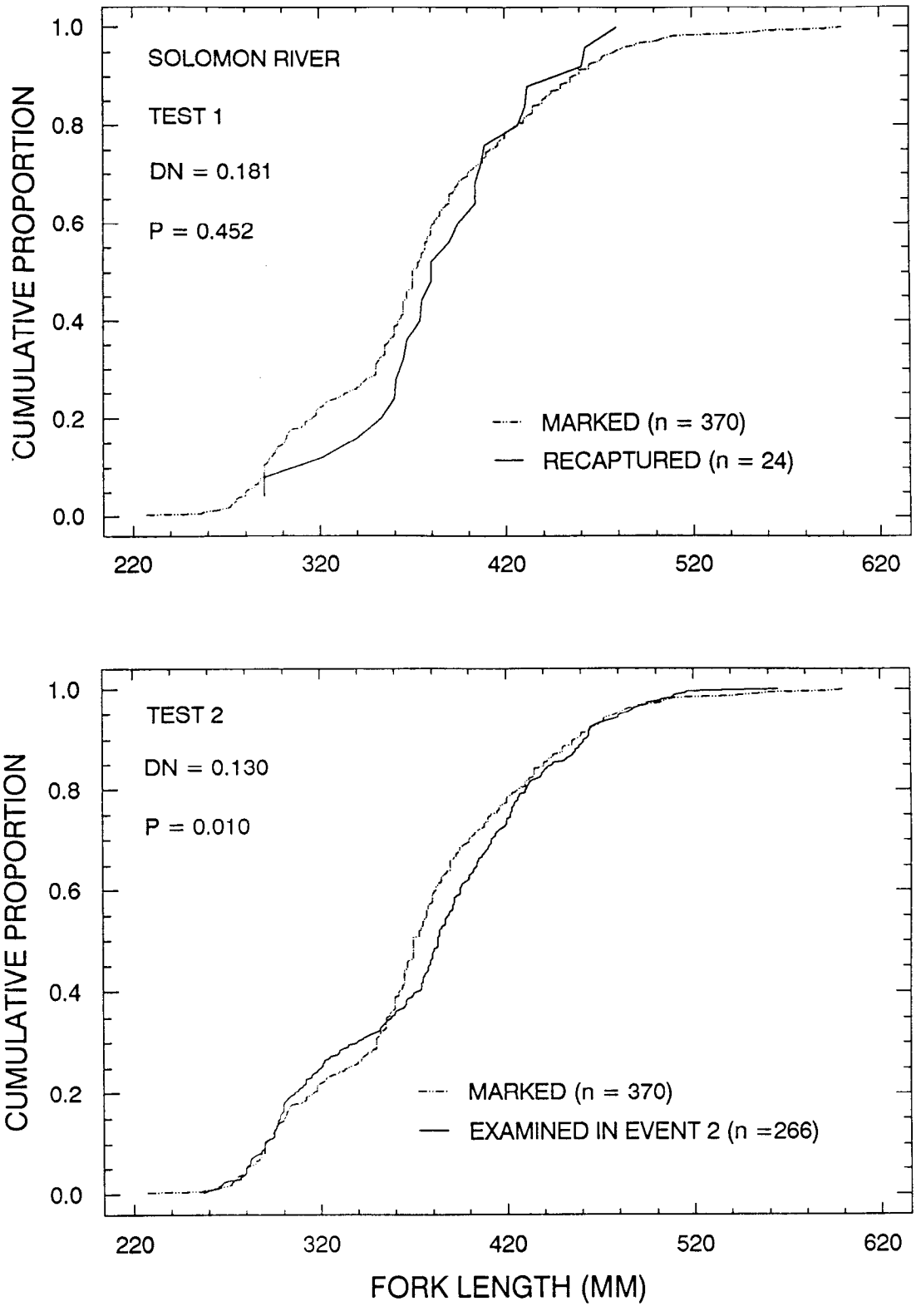

Figure 7. Cumulative length distribution plots (tests 1 and 2) of Dolly Varden sampled from the Solomon River in 1991.

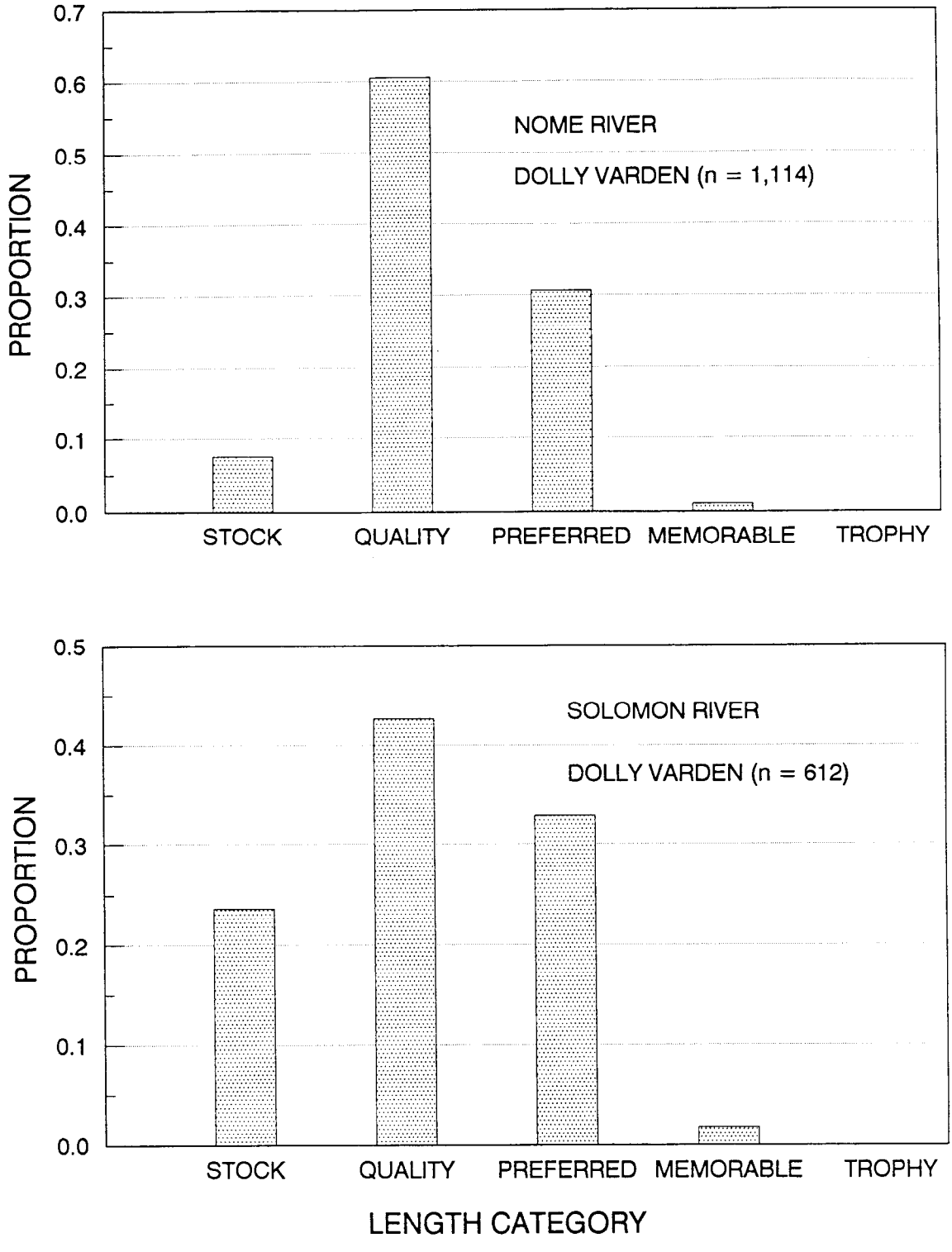

Figure 8. Relative Stock Densities of Dolly Varden sampled from the Nome and Solomon rivers in 1991.

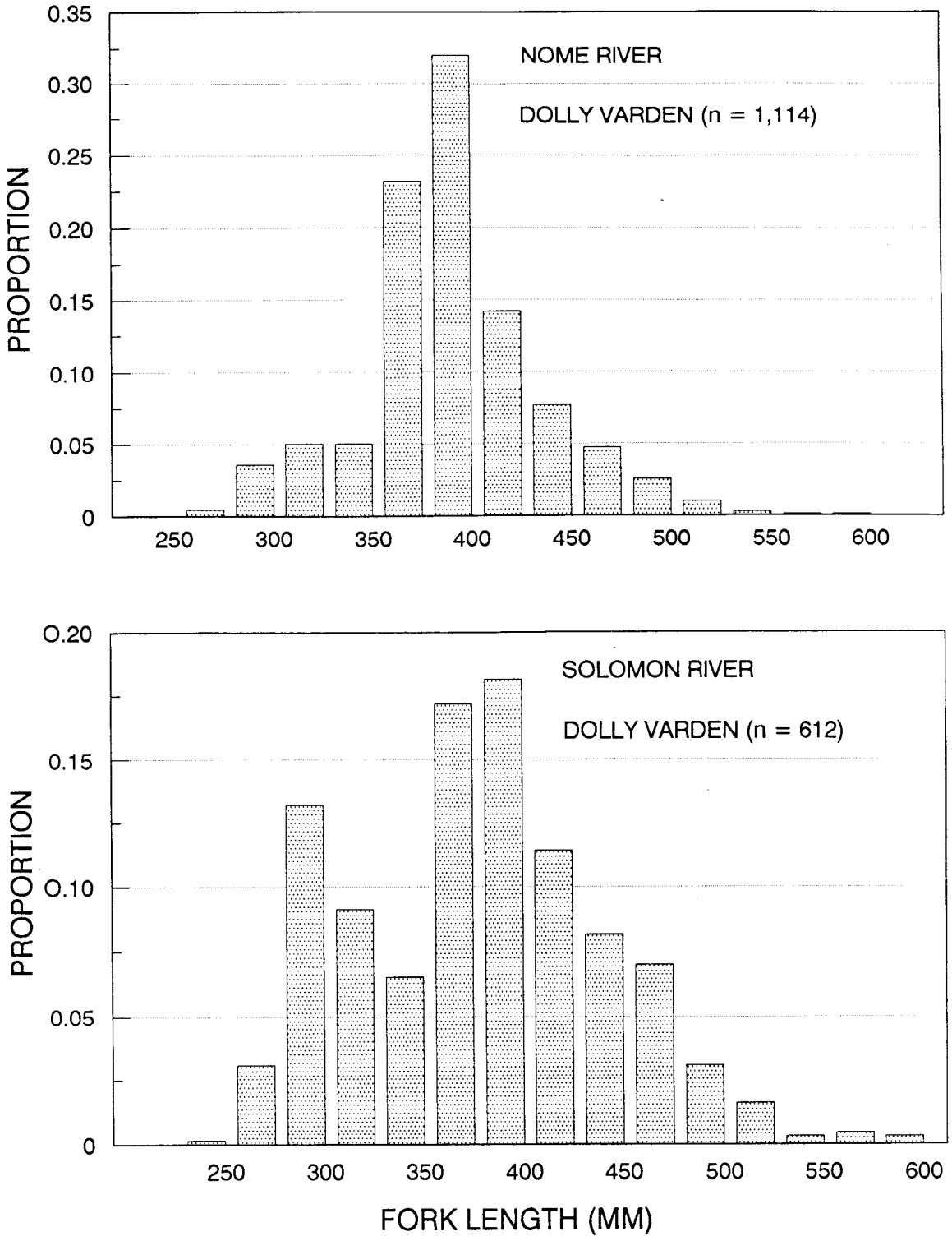

Figure 9. Length composition (by 25 mm increments) of Dolly Varden from the Nome and Solomon rivers in 1991.

Table 2. Length composition of Dolly Varden in the Nome and Solomon rivers during 1991.

	RSD Category[a]				
	Stock	Quality	Preferred	Memorable	Trophy
Nome River					
Number sampled	85	674	342	13	0
RSD	0.08	0.61	0.31	0.01	0.00
Standard Error	<0.01	0.02	0.02	<0.01	0.00
Abundance	229	1,819	923	35	0
Standard Error	29	136	77	10	0
Solomon River					
Number sampled	145	261	195	11	0
RSD	0.24	0.43	0.32	0.02	0.00
Standard Error	0.02	0.02	0.02	<0.01	0.00
Abundance	941	1,694	1,266	71	0
Standard Error	183	316	240	25	0

[a] Minimum lengths for Dolly Varden RSD categories (Gablehouse 1984) are: Stock 200 mm FL; Quality - 320 mm FL; Preferred - 400 mm FL; Memorable - 510 mm FL; and, Trophy - 640 mm FL.

Table 3. Length composition (by 25 mm increments) of Dolly Varden from the Nome and Solomon rivers during 1991.

Fork Length Range (mm)	Nome River					Solomon River				
	Sample Size	Estimated Proportion	Standard Error	Estimated Abundance	Standard Error	Sample Size	Estimated Proportion	Standard Error	Estimated Abundance	Standard Error
201 - 225	0	0.000	0.000	0	0	0	0.000	0.000	0	0
226 - 250	0	0.000	0.000	0	0	1	0.002	0.002	6	6
251 - 275	5	0.005	0.002	14	6	19	0.031	0.007	123	35
276 - 300	40	0.036	0.006	108	18	81	0.132	0.014	526	109
301 - 325	56	0.050	0.007	151	22	56	0.092	0.012	363	80
326 - 350	56	0.050	0.007	151	22	40	0.065	0.010	260	61
351 - 375	258	0.232	0.013	696	62	105	0.172	0.015	682	137
376 - 400	357	0.321	0.014	963	80	111	0.181	0.016	721	143
401 - 425	158	0.142	0.010	426	43	70	0.114	0.013	454	96
426 - 450	86	0.077	0.008	232	29	50	0.082	0.011	325	73
451 - 475	53	0.048	0.006	143	22	43	0.070	0.010	279	65
476 - 500	29	0.026	0.005	78	15	19	0.031	0.007	123	35
501 - 525	11	0.010	0.003	30	9	10	0.016	0.005	65	23
526 - 550	3	0.003	0.002	8	5	2	0.003	0.002	13	9
551 - 575	1	0.001	0.001	3	2	3	0.005	0.003	19	12
576 - 600	1	0.001	0.001	3	2	2	0.003	0.002	13	9
Total 201 - 600	1,114	1.000		3,006		612	1.000		3,972	

DISCUSSION

Two tag recoveries during September 1991 suggested that fall populations of Dolly Varden, once fish have migrated into freshwater, are not entirely closed. A fish was recaptured from the Solomon River which had been marked in the Nome River 12 days before, and a fish marked in the Solomon River was recaptured from the ocean near Cape Nome 15 days after it was tagged. The latter fish may have been driven out of the river by road construction activities as discussed later, but there was no apparent reason for the fish to have moved from the Nome River to the Solomon River. It was surprising to find movements of this kind. I have never observed fall inter-system movements in Kotzebue Sound Dolly Varden populations. However, Armstrong (1974) found that nonspawning Dolly Varden commonly enter streams in southeast Alaska during the fall only to leave after a few days. If movements of this type were common in the Nome area, they would have biased the abundance estimates high. Since only two fish are known to have left an overwintering area in 1991, it is thought that Dolly Varden in the Nome area do not commonly leave a river after once having entered it in the fall and that movements of this type did not significantly influence the abundance estimates during 1991.

Few fish between 200 and 270 mm FL were sampled in either river. I believe that samples reflect the relative lack of small Dolly Varden present in the migratory populations. Dolly Varden first migrate to sea between the ages of 2 and 5 years. For populations farther north, smoltification occurs when fish are from 120 to 160 mm FL. The mean length those returning to fresh water after their first ocean migration is 280 mm FL with few fish < 250 mm FL, and none < 220 mm FL (DeCicco 1985). Smolt size is probably similar in Seward Peninsula streams and since no migratory Dolly Varden < 227 mm FL were sampled, it is thought that abundance estimates apply to the entire migratory populations. Sampling areas in both rivers were chosen after the first sampling event which extended some distance upstream and downstream of the distribution of overwintering Dolly Varden. It is thought that sample sections contained all overwintering concentrations of Dolly Varden in both rivers, but aerial overflights would confirm this in the future.

The distribution of overwintering Dolly Varden in both rivers was uneven with concentrations of fish occurring intermittently throughout the sampling areas. Areas of concentration probably represent habitats critical to the overwinter survival of fish in these rivers. Some spawning fish were present in most areas of fish concentration. Springs were observed at some locations where fish were concentrated, and it is suspected that springs are present in additional locations where spawning fish were observed. Springs are critical to spawning and overwintering of char on the North Slope and in northwestern Alaska (Craig and McCart 1974, McCart 1980, DeCicco 1985, 1989).

Road construction near the Solomon River during the summer of 1991 influenced the distribution of Dolly Varden during the recapture event in September. During the mark event, 211 Dolly Varden were marked at the mouth of Shovel Creek which entered the Solomon River via a large culvert. Between the two events, the culvert had been removed and the riverbank adjoining the road had been reinforced with large boulders. This activity had apparently driven fish from the area. During the recapture event only one fish was examined from

this location. Fish previously marked in this location were taken well upstream and downstream during the recapture event.

Two tag recoveries indicated that Dolly Varden on the Seward Peninsula may not always overwinter in the same river. One fish captured in the Nome River had been marked in the Shaktoolik River in September 1990 (Kretsinger 1991), another fish captured and marked in the Nome River was recaptured by an angler in the Unalakleet River in February 1991. Movements of this type have been observed elsewhere in northwestern Alaska (DeCicco 1985, 1989).

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APPENDIX A

Appendix A1. List of numbered tags and fin clips used on Dolly Varden sampled from the Nome, Solomon and Cripple rivers during 1991.

Location	Month	Total	Tag Numbers	Color	Fin Clip
Nome River	June	20	25050 - 25069	Blue	Adipose
	June	18	52679 - 52686	Green	Adipose
	July	28	25070 - 25097	Blue	Adipose
	July	14	25100 - 25113	Blue	Adipose
	August	2	25114 - 25115	Blue	Adipose
	August	2	25098 - 25099	Blue	Adipose
	September	50	25000 - 25049	Blue	Adipose
	September	343	25116 - 25458	Blue	Adipose
	September	168	25460 - 25627	Blue	Adipose
	September	371	25629 - 25999	Blue	Adipose
	September	146	26050 - 26195	Blue	Adipose
Solomon River	September	611	54000 - 54610	Green	Adipose
Cripple River	June	41	25000 - 25040	Blue	Adipose

APPENDIX B

Appendix B1. Data files[a] used to estimate parameters of Dolly Varden populations on the Seward Peninsula in 1991.

Data file	Description
W0040LA1.DTA	Data for Dolly Varden sampled from the Nome River during June, July and August, 1991.
W0040LB1.DTA	Data for Dolly Varden sampled from the Nome River during September, 1991.
W0150LA1.DTA	Data for Dolly Varden sampled from the Solomon River during 1991.

[a] Data files have been archived at, and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, Alaska 99518-1599.

APPENDIX C

Appendix C1. Inference as a means to detect bias due to gear selectivity.

Results of Hypothesis Tests (K-S and χ^2) on Lengths of Fish Marked during First First Event and Recaptured during Second Event	Results of Hypothesis Tests (K-S) on Lengths of Fish Captured during First Event and during Second Event
Case I:	
"Accept" H_o	"Accept" H_o
There is no size-selectivity during either sampling event.	
Case II:	
"Accept" H_o	Reject H_o
There is no size-selectivity during the second sampling event but there is during the first.	
Case III:	
Reject H_o	"Accept" H_o
There is size-selectivity during both sampling events.	
Case IV:	
Reject H_o	Reject H_o
There is size-selectivity during the second sampling event; the status of size-selectivity during the first event is unknown.	

Case I: Calculate one unstratified abundance estimate, and pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition.

Case II: Calculate one unstratified abundance estimate, and only use lengths, sexes, and ages from the second sampling event to estimate proportions in compositions.

Case III: Completely stratify both sampling events, and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Pool lengths, ages, and sexes from both sampling events to improve precision of proportions in estimates of composition, and apply formulae to correct for size bias to the pooled data.

Case IV: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Also, calculate a single estimate of abundance without stratification.

- continued -

Appendix C1. (Page 2 of 2).

Case IVa: If the stratified and unstratified abundance estimates for the entire population are dissimilar, discard the unstratified estimate. Only use the lengths, ages, and sexes from the second sampling event to estimate proportions in composition, and apply formulae to correct for size bias to data from the second event.

Case IVb: If the stratified and unstratified abundance estimates for the entire population are similar, discard the estimate with the larger variance. Only use the lengths, ages, and sexes from the first sampling event to estimate proportions in compositions, and do not apply formulae to correct for size bias.

APPENDIX D

Appendix D1. Observed movements of recaptured Dolly Varden in the Nome River during September, 1991.

		Number of Dolly Varden Marked in:		
		Area 1	Area 2	Area 3
Number of Fish Recaptured in:	Area 1	10	3	4
	Area 2	2	8	13
	Area 3	7	9	67[a]

[a] One additional fish which was recaptured in area 3 without a tag was subsequently added to this group.